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Subject: Re: error estimates (a little off-topic maybe)

Posted by [wilms](#) on Thu, 03 Oct 2002 20:14:12 GMT

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In article <Pine.LNX.4.44.0210031925160.1364-100000@umzog.ulo.ucl.ac.uk>, src <src@umzog.ulo.ucl.ac.uk> wrote:

>

> This question might be a little off-topic, but since a lot of  
> scientists/engineers use IDL, someone may have some ideas.

>

> What I'd like to do is measure the amplitude (and estimate the error) of a  
> peak in a Fourier transform. Now I could fit the peak with a Gaussian  
> function, and if I use CurveFit, it will give me an error estimate too.  
> The problem is, the error estimate is dependent on on the number of points  
> fitted, as one might expect with such routines. Since I wish to perform a  
> hypothesis test later, I could get the outcome I want just be increasing  
> the number of frequency points in the Fourier transform, so that the error  
> is small and my hypothesis is accepted.

I am not entirely sure what you mean by increasing the number of frequency points. If you're using a Fourier transform and have equally spaced numbers, then the number of frequency points is fixed by the number of Fourier frequencies and it is quite difficult to simply increase the number of points...

Also, note that if you're analyzing a time series, then the uncertainty of the power-spectrum is well known through its  $\chi^2$  properties (the power spectrum is the square of the fourier transform of a time series, and it is easy to show that its uncertainty is a  $\chi^2$  distribution with 2 degrees of freedom, i.e., the uncertainty of each value of the power spectrum is as large as the value itself). Similar arguments also apply to any fourier transform of real measured data, which I assume you're performing. Thus, although you might not be aware of it, you most probably can compute real error bars from your data, and should do so :-).

Unrelated to this: please note that the "errors" returned from curvefit are normally NOT the formal errors of the fit parameters. This is only true if the fit parameters you use in your fit are statistically independent from each other (i.e. if the Hessian matrix at the minimum of the  $\chi^2$  is diagonal). In general, this is not the case and you need to determine the uncertainty of your fitting parameters from the shape of the  $\chi^2$  contour. A nice discussion of this can be found, e.g., in Bevington & Robinson. Some routines to perform such an error determination either for the case of one or two parameters (the latter for the case that two parameters are correlated) can be found at

<http://astro.uni-tuebingen.de/software/idl/aitlib/fitting/>

(if I am allowed to enter this shameless plug for our software here, that is ;- ) ). These routines are to be used in conjunction with Craig Marquardt's great IDL fitting routines, which I'd recommend as a replacement of mpfitfun.

- >
- > Does anyone know of a way of estimating such an error which is not
- > dependent on the number of points fitted?

nope, you will always need to assign an uncertainty to your points, and there is no such thing as data without errors...

Cheers,

Joern

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